

REMARKS:

Claims 1-20 are in the case and presented for consideration.

A clean copy of Claim 5 is attached at the end of this amendment pursuant to the Examiner's request.

Claims 1-10 have been rejected under 35 U.S.C. 103(a) as obvious from Canadian Patent 2,142,195. In particular, the Examiner states that the Canadian Patent 2,142,195 teaches the use of homolog alcohols such as methanol and ethanol to produce homologs of carbonated alkoxymagnesium compounds, such as methoxymagnesium methyl carbonate and ethoxymagnesium methyl carbonate. The Examiner further states that it would be obvious to use the homolog propanol to produce the homolog carbonated magnesium propoxide, because "other suitable carbonated magnesium alkoxides can be prepared by either of the above methods using other solvents to produce the corresponding homologs of methoxymagnesium methyl carbonate".

It is respectfully submitted that the use of the alcohol solvent homolog, propanol to produce the homolog carbonated magnesium propoxide under the same method described in Canadian patent 2,142,195 causes unexpectedly destructive results which are contrary to the exemplified successful results of methanol and ethanol usage in the Canadian Patent 2,142,195 and would not enable one skilled in the art to practice the '195 invention.

The success of the invention described in the '195 Canadian patent is based on a specific method that cannot be used for

preparing carbonated magnesium propoxide in propanol because such a method of preparation would be destructive to cellulose material. The Canadian patent discloses a process for preparing methoxymagnesium methylcarbonate and ethoxymagnesium ethylcarbonate which comprises the steps of refluxing magnesium metal in methanol (or ethanol) to give a suspension of magnesium methoxide in methanol and, after cooling, saturating the suspension with carbon dioxide. If this method is employed to prepare carbonated magnesium propoxide, very high dilutions are needed in order to obtain a good conversion of magnesium. An optimized process would reflux 124 mg of magnesium in 100 cm³ of propanol for 24 hours, obtaining a highly diluted mixture of magnesium propoxide (solid) and propanol (liquid) with a conversion of Mg of 95%.

A carbon dioxide current is then passed through the mixture so that a solution containing only a 6% (w/v) of carbonated magnesium propoxide in propanol is obtained. This mixture presents a critical drawback since when combined with the hydrofluorocarbon solvent, the final mixture will contain very low levels of the active compound carbonated magnesium propoxide and very high levels of propanol, which makes the mixture useless to the deacidification of cellulose material since high levels of propanol can cause alterations to inks, adhesives, plastics, and glueing of the books.

On the other hand, the use of propanol to produce carbonated magnesium propoxide by the method disclosed in Applicant's invention is unexpectedly successful for the de-acidification of cellulose material. By affecting the refluxing of magnesium and propanol in the presence of a catalyst such as iodine, as exemplified in procedures A, B and C in examples 1.3, 1.4 and 2.1 of the Applicant's patent application, the reaction proceeds with high conversion of magnesium of 95% in much lower dilutions. An optimized process refluxes 4857 mg of magnesium in 100 cm³ of propanol for 2 to 3.5 hours, obtaining a mixture of magnesium propoxide (solid) and propanol (liquid) with a conversion of Mg of 95%.

A current of carbon dioxide is then passed through the mixture so that a solution containing about 32% (w/v) of carbonated magnesium propoxide in propanol is obtained. When this composition is mixed with the hydrofluorocarbon solvent, the final mixture contains higher levels of the carbonated magnesium propoxide active compound and very low levels of propanol.

Because propanol and carbonated magnesium propoxide are not specifically mentioned in the Canadian '195 patent, and the use of propanol produces poor results under the '195 method, it is believed that use of propanol to produce carbonated magnesium propoxide for successfully de-acidifying cellulose-type material is not obvious from the Canadian patent.

Furthermore, the use of propanol to produce carbonated magnesium propoxide has advantages that are not taught or suggested by the '195 patent.

First, Carbonated magnesium di-n-propylate presents a higher solubility in n-propanol than the solubility of its lower methoxy/ethoxy homologs in their corresponding solvents. This characteristic confers the Applicant's invention the advantages of higher concentrations of carbonated magnesium di-n-propylate and lower concentrations of alcohol.

Carbonated magnesium di-n-propylate can be produced at a concentration of 30-50% (w/v) of active product in n-propanol (see present patent application page 10, lines 27-28 and examples 1.3, 1.4, 1.5 and 2.2), while the '195 patent prepares carbonated magnesium di-n-methylate or carbonated magnesium di-n-methylate at a concentration of only 5-20% (w/v) of active product in methanol or ethanol (see '195 patent page 6, lines 21-22).

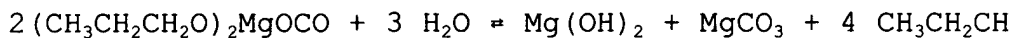
In the Applicant's invention, the carbonated magnesium di-n-propylate and propanol solution is diluted as a final product in the Applicant's invention to a concentration of 1-10%, preferably 3.8-4.5% (w/v) (see the specification, page 11, lines 24-28; claim 2-4) in a hydrofluorocarbon selected from 1,1,1,2-tetrafluoroethane and 1,1,1,2,3,3,3-heptafluoropropane. The '195 patent teaches the dilution of the carbonated magnesium di-n-methylate or carbonated magnesium di-n-methylate to a concentration of 0.1 to 2% (w/v) in a hydrochlorofluorocarbon and/or hydrofluorocarbon final product.

As shown above, the final product of the present application contains higher amounts of the carbonated magnesium di-n-propylate active product than the products disclosed in the '195 patent. Consequently, the deacidification efficiency of the final product of the Applicant's invention will therefore be higher. In addition, the alkaline reserve, which protects the cellulose-type material from a subsequent re-acidification due to acid atmospheric pollutants and/or liberated acids during ageing, is also higher.

Accordingly, the levels of alcohol in the final product of the Applicant's invention are lower than in the final product of the Canadian '195 patent. Since a solvent excess can cause alterations to inks, adhesives, plastics, gluing, etc., employed with the cellulose-type material, the use of a lower quantity of n-propanol avoids numerous disadvantages caused by a high quantity of methanol, such as toxicity, modifications of ink and dye solubility, plastic swelling, natural glueing and vegetal/animal gum dissolution.

The second advantage of applicant's invention is that carbonated magnesium di-n-propylate is much less reactive than carbonated magnesium methoxy and ethoxy derivatives. This characteristic confers to carbonated magnesium di-n-propylate two main advantages as a deacidification product over the methoxymagnesium and ethoxymagnesium homologs of the '195 patent. It is not hydrolysed as fast as the '195 homologs by atmosphere moiety.

Carbonated magnesium di-n-propylate is hydrolysed according to the following reaction:



Since it is not hydrolyzed as fast as the homologs disclosed in the '195 patent, the equilibrium of this reaction, in comparison to its lower homologs, shifts to the left. Thus, the quantity of available active carbonated magnesium di-n-propylate product will be higher, and consequently, the quantity of free solvent will be lower. Therefore, the deacidification efficiency of the applicant's carbonated magnesium di-n-propylate product is better than the '195 patent deacidification efficiency, the likelihood of reacidification is reduced, and disadvantages due to a reduction in solvent excess are eliminated.

Also, the carbonated magnesium di-n-propylate product in applicant's invention is not hydrolyzed easily by hydration water of cellulose-type material, especially by the less "reactive fraction". Cellulose-type material has different kinds of hydration water, such as for example about 5.5-6.5% at a relative humidity of 45-55%. A less "reactive fraction" is for example water lodged in fiber lumen and cellular walls or water forming hydrogen bridges with cellulosic fibers, and a more "reactive fraction" is for example occlusion water at about 1.4-1.8% of hydration water.

Typically, before deacidification treatment of cellulose-type material, it is necessary to perform a dehydration process in order to remove hydration water which could hydrolyz the deacidification

product. Occlusion water, or more "reactive fraction" of hydration water, is the first type of water to be removed from cellulose-type material when it is subjected to a thermal and vacuum dehydration.

If carbonated magnesium di-n-propylate is used, a moderate dehydration of cellulose-type material is necessary in order to remove only occlusion water from it. This is because carbonated magnesium di-n-propylate, which is less reactive than its lower carbonated magnesium alkoxides (e.g., methoxy and ethoxy), will not react with the less "reactive fraction" of hydration water from cellulose-type material. Lower carbonated magnesium alkoxides on the other hand, react with almost all the water from cellulose-type material.

The use of carbonated magnesium di-n-propylate requires a moderate dehydration of cellulose-type material before deacidification, which supposes the advantages of less vigorous conditions of dehydration, such as reduction of dehydration time (4 h at 50 °C and 2-5 mbars for propanol as opposed to 24 h at 50 °C and 12 h at 45 °C and 2 mbar for methanol), and better dehydration results. Hydrolysis of deacidification is slow and allows the homogeneous deposition of magnesium carbonate white powder on paper.

The reduced dehydration times with better results can be observed from the following table I. In table I, data from a book restoration study of Old Stocks from Library of Higher Technical

School for Industrial Engineering of Barcelona (Polytechnic University of Cataluna) are collected.

Then, 58 assays were carried out in treatment equipment with 15.5 to 16.5 kg of XIX Century books for every batch, varying reactant concentrations and average dehydration values between 1.4 % and 2.1 % throughout the 58 batches. Dehydration values represent the total loss of water, in general occlusion water, for 100 g of non-dehydrated paper. Variability of dehydration values is directly related to paper grade (for glazed papers about 1.4 % and for porous papers about 2.1 %). These dehydration values are reached for 16 kg of treated papers in an average time of 3 hours, verified by weighing before and after dehydration, and for every paper grade and every batch.

Table I

Reactant dose (expressed in magnesium carbonate)	Book weight (in Kg)	Alkaline reserve	Average pH	Dehydration (in hours)
145 g	16.5	0.87-0.91	9.35	3
153 g	15.4	0.94-0.98	9.38	3
175 g	16.2	1.02-1.05	9.40	3
186 g	15.1	1.20-1.22	9.30	3
210 g	14.8	1.39-1.41	9.45	3
230 g	15.2	1.48-1.50	9.38	3

Alkaline reserve and pH values depend on reactant dose. Doses at 186, 210, and 230 g. provide suitable values of alkaline reserve as a bulk deacidification method. By this method alkaline reserves

up to 8-9 % have been obtained depending on reactant dose. 58 assays have been carried out, each with very similar results, except in two cases in which dehydration time was reduced to a total time of 1 h at 45 °C under a vacuum of 3 mbars. These assays have been carried out in a programmed way to determine the dehydration time. Dehydration attained in 1 h was about 0.5 % from the total.

The dehydration method in the system with the alkoxide carbonated magnesium di-n-propylate allows a suitable application with a bulk dehydration of about 40-80 kg during 4 h at 50 °C and 2-5 mbars.

Hence, Applicant's claimed invention has demonstrated that production of carbonated magnesium di-n-propylate from propanol presents unexpected and very important advantages over the methoxymagnesium methylcarbonate/methanol and ethoxymagnesium ethylcarbonate/ethanol compositions disclosed in the '195 reference. Therefore, it would not have been obvious to produce carbonated magnesium di-n-propylate from propanol based on the disclosure of the '195 patent.

Finally, new Claims 11-20 recite the limitation that the concentration of carbonated magnesium di-n-propylate is 30-70% in n-propanol. The '195 patent does not teach or suggest such a high concentration of carbonated magnesium di-n-propylate or such a low concentration of alcohol solvent. Because carbonated magnesium di-n-propylate cannot be produced at a concentration of 30-70% in n-

propanol by the method disclosed in the '195 patent, Claims 11-20 are nonobvious.

Accordingly, the application and claims are believed to be in condition for allowance, and favorable action is respectfully requested. No new matter has been added.

If any issues remain which may be resolved by telephonic communication, the Examiner is respectfully invited to contact the undersigned at the number below, if such will advance the application to allowance.

Further, the Commissioner is authorized to charge the additional claims to our Deposit Account No. 14-1431.

Favorable action is respectfully requested.

Respectfully submitted,



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5. A procedure for obtaining a product for deacidification of cellulose-type material according to claim 1, which comprises; (i) preparing a solution of carbonated magnesium di-n-propylate in n-propanol, and (ii) diluting the solution obtained in stage (i) by addition of a hydrofluorocarbon diluent.